EDINBURGH UNIVERSITY.

PROFESSIONAL EXAMINATION FOR

M. D.

T H E S I S.

GENERAL ANAESTHETICS.

ARTHUR RUPERT HALLAM.

Apologizing for
the trouble I have
caused you
I remain
Yours truly
Rupert Hallam

79, HANOVER STREET,
SHEFFIELD.

Feb 1/05

Dear Sir
I regret to say
that owing to sudden
illness of my partner
I shall not be able
to be present at the
graduation ceremony
on Saturday.

Norwood Rise
Pitsmoor
Sheffield

HOTEL ST GEORGE
LIVERPOOL

TELEPHONE Nº 0137.

July 8th 1904

M.D

Degree withheld till he can be present JS

John S. Clarke Esq.

Dear Sir

Re my application to be exempted in absentia. I beg to inform you that my absence abroad will be after December 1904.

Yours Truly

C. Rupert Garland

I am sailing for
Japan on July 9/04
I remain
Yours faithfully
A R Hallam

Norwood Rise
Pitsmoor
Sheffield
July 5th/04

The Dean of the
Faculty of Medicine

Dear Sir

I am a candidate
for the degree of M.D.
If in case I am successful
I beg to apply to
be exempted in absentia.
My reason for this
request is because

16th
6.7.04

GENERAL ANAESTHETICS.

Systematic observations of the administration and mode of action of general anaesthetics have been much practised since the days of Sir J. Y. Simpson. Many papers bearing on the subject have appeared from time to time in the Medical papers, and many treatises by Specialists have been issued. In spite, however, of all this activity, the anaesthetics in present use are not without danger even in skilled hands.

Considerable importance is now given to the teaching of this subject in all Schools of Medicine. The Royal College of Surgeons England require a certificate of Efficiency from their candidates for Membership. To most of the large hospitals Specialists are now attached, a provision which will greatly tend to improve the capabilities of the average practitioner.

Having been on the Resident Staff of a very active general Hospital for the last 2½ years, I have had exceptional opportunities for observing the action of general anaesthetics. During this time I have held two surgical appointments, one ophthalmic and one medical, the latter involving the practical teaching of anaesthetics. Alto-

gether I roughly estimate that I must have given 1500 administrations. By far the greater part of these have been chloroform and ether, next in frequency nitrous oxide and a comparatively small number of the more recent anaesthetics such as Ethyl Chloride and mixtures containing that preparation..

In endeavouring to make this a clinical treatise I have thought fit to exclude all reference to the discovery and history of the above mentioned Drugs, also the experimental and physiological details, and have taken accurate notes of a considerable number of cases, especially of those which have presented features somewhat out of the common.

The following is a short summary of the arrangement and contents of the following pages:-

Selection of Anaesthetic#:-

State of the Patient.

Nature of the operation.

Preparation of the Patient:-

Chloroform.

Ether.

Soemnoform.

Difficulties and Remedies:-

After Effects.

Selection of Anaesthetic.

Much controversy has taken place over this

question respecting the two anaesthetics - Chloroform and Ether, now in such general use, opinions are apparently as much divided as ever as to which is the better of the two. Nitrous Oxide and the more recently known Ethyl Chloride and substances containing it should, it appears to me be placed in a different category seeing that they are only suitable for short anaesthesia and therefore inadmissible for any operation of long duration.

Contrasting the two former anaesthetics no doubt the first consideration is as to their relative safety and in this we are more or less aided by the large number of statistics which have been compiled by many authorities in this country and abroad. Unfortunately, these statistics vary greatly and one cannot help thinking that much depends on the skill of the individual administrating these drugs, and the circumstances under which they are given. Moreover, in many cases the question arises as to whether or no the operation has not been the cause of death.

At St. Bartholomew's Hospital during the years 1876-96 in all, there were 58,787 administrations of chloroform and ether. The following table shows the death Rate:-

Anaesthetic.	Administration.	Deaths.	Death Rate.
Chloroform.	30.871	21	1 in 1,470.
Ether.	27.916	4	1 in 6,979.

(B.M.J.April 14th, 1877).

Mr. Roger Williams in his report to the Hyderabad Commission (page 204) also quotes the statistics taken from the records of St. Bartholomew's Hospital for 10 years, and from these the proportion of deaths works out as follows:-

Chloroform:- 1 death in 1,236.

Ether:- 1 death in 4,860.

Against these statistics, however, must be placed Dr. Lawrie's figures (Chloroform. Lawrie. page 118) of only one death in 17.300 cases.

Dr. Ormsby of Dublin has collected some hundreds of thousands of administrations and deduced from these that the Death Rate in chloroform is 1 in 2873, and Ether 1 in 23204.

(B.M. J. April 14th, 1877).

On the Continent some observers give a considerably lower Death Rate for chloroform, namely 1 in 5,500 Vide (Archiv. für Kliniche Chirurgie. Vol. 42. page 282).

On perusal of these figures one might at first conclude that Ether was considerably safer as a general anaesthetic than chloroform. This, however, is, as I am convinced, not the case for leaving out of account the personal element one has to consider the method of administration, and also the comparatively speaking numerous deaths from bronchitis and pneumonia following Ether.

The Method of administrating chloroform is of the utmost importance. Julliard of Geneva

in his table published in 1891 (Review of the Swiss Medical World) states that out of 151 deaths he collected, 37 of these occurred when it was given with an Inhaler. Now, as yet, these have been most unsatisfactory, and have been condemned by most of the modern authorities, also by Syme many years ago. These fatalities should hardly be considered with those taking place under the open method.

A still greater fallacy in these statistics is as previously mentioned, the disregard of the deaths which take place from Ether - pneumonia and bronchitis. These do undoubtedly occur somewhat frequently, and in many cases are, I am inclined to think, disregarded in statistics. In my own experience I can recall one death which undoubtedly, in my opinion, was due to pneumonia following the administration of Ether. The patient was a woman, age 42. The operation was gastro-enterostomy. She died four days later and the post mortem shewed broncho-pneumonia in both lungs. The site of operation being quite healthy. I also have the notes of a case of Radical Cure for Hernia in a woman age 25. This patient on the day following operation developed definite physical signs of pneumonia in one lung, and was for seven days in a very grave condition. The wound healed perfectly by first intention. Eventually, she made a good recovery. The temperature in this case rose 20 hours after the operation. No pneumococci were found in the sputum. The anaesthetic in

both these cases was Ether given with a Clover's Inhaler. I have seen numerous cases of bronchitis follow the administration of ether, but can only recall three cases after chloroform had been administered. On the other hand, I believe more accidents happen during the actual administration of chloroform than Ether. I have seen a fatality under each of these anaesthetics. It was my misfortune to be the administrator of the latter drug when the death occurred. Later on I have given a short account of these two cases under their separate headings.

Next to the question of safety comes the suitability of the anaesthetic for the operation. Here again I consider chloroform superior. The disadvantages of ether are:-

Firstly, the excessive bronchial secretion that frequently takes place during the administration, causing considerable trouble from coughing and cyanosis. When administered by the open method the intense coldness of the vapour certainly involving irritation of the mucous membrane of the respiratory tracts. It is inadmissible in tropical climates.

The advantages over chloroform are firstly the stimulating effect in cases of severe debility.

It can also be given without much danger in the sitting posture, not being so liable to

cause syncope as chloroform.

The disagreeable sensations when inhaling ether need not be laid much stress upon seeing they may be overcome by administrating the nitrous oxide - ether sequence or soemnoform - ether sequence.

State of the Patient:-

This is of decided importance in selecting the anaesthetic. Firstly the age of the patient:- Children take anaesthetics well and in my own experience cause little trouble. Lawrie in his work on Chloroform (P.52) recommends the mask to be "Jammed" down on to the child's face. This he does with the purpose of making the child cry. He goes on further to say that crying makes the child breathe regularly. With due deference to his undoubted experience I cannot agree with this latter statement; during the crying children often unexpectedly take a very long and deep inspiration and I think the practice is much to be condemned. On Page 47 he states that "abolition of the corneal reflex is the infallible sign of anaesthesia." This statement I am inclined to think most authorities would dispute in the case of children. The inexperienced anaesthetist will often inform the surgeon that the child is "ready" after finding no corneal

reflex. Much to his surprise at the touch of the knife the child screams loudly.

Ether I consider unsuitable in young children for I find the usual form of Clover's Inhaler is too large and cumbersome and if it is given in any form of open inhaler the intense coldness of the vapour is a great objection. In elderly patients ~~on account of~~ the emphysema so frequently present prohibits the use of ether.

The physique bears an important relation to the ease with which a patient is anaesthetised; this is especially so in the earlier stages when struggling is apt to occur. As most authorities agree it is in these cases that fatal over-dosing is so apt to occur due to the long and deep inspirations that follow the excitement.

The habits: Alcoholic patients are probably the most difficult subjects for the anaesthetist to deal with, for they generally struggle violently and are frequently bronchitic. I think on the whole chloroform is the more suitable to use in spite of the danger during the excitable stage.

Hewitt, in his work (Anaesthetics and their Administration, P.120) mentions the fact that tobacco smokers, in a lesser degree, are difficult to anaesthetise.

I have noticed that a patient who struggles violently under one administration will do so on following ones, although usually it is a prefer-

able to administer to patients who have suffered before.

Disease of patients:- Circulatory.

The danger of anaesthetics has I think been somewhat exaggerated. I have given both chloroform and ether in cases of aortic regurgitation, Mitral Stenosis, mitral regurgitation and also in a case of Dextro-cardia. In none of these cases did alarming symptoms occur. The notes of one of the cases of mitral regurgitation are especially interesting; they are briefly as follows:-
F. aet 54. Malig. Dis. of stomach. Operation partial gastrectomy. Had mitral murmur conducted to axilla. Apex beat 5th space ½ inch external to nipple. Pulse 90; this patient was given ether in Clover's Inhaler; was under for no less than 2 hrs. 50 min. during which time she required 6½ ounces of Ether. There never was any necessity for any stimulant, such as strychnine or brandy. The P. rate was at the close of the operation 96. No doubt compensation was well established in this case, but strange to say, four days later she had an attack of Dyspnoea, tachy-cardia and was very cyanosed.

The fatality I have previously mentioned which took place under chloroform showed on Post Mortem examination no valvular disease but considerable fatty infiltration of the left ventricle.

It is noteworthy than an irregular pulse will

sometimes become quite regular, under the administration.

I think with due care the anaesthetist should have little difficulty with a patient who has some cardiaclesion with fair compensation. Naturally, the cardiac case with oedema and orthopnoea is in a very dangerous state if he is subjected to any disturbance.

Respiratory system: Case of enlarged tonsils would at first sight be thought to give anxiety to the anaesthetist on account of the narrowing of the upper air passage but in an experience of about 500 cases there has only been one case with alarming symptoms. This took place immediately following the removal of the tonsils and was due entirely to the entrance of a clot into the larynx. Laryngotomy was performed and gave speedy relief. The child was apparently too deeply narcotised and was unable to cough up the foreign body. I may mention that it is the custom here to remove both tonsils and adenoids with the patient's head extended over the end of the table. In this position provided the patient is not too deeply anaesthetised, I consider there is little danger.

It has always been my custom in cases of pulmonary Phthisis to give chloroform when an operation is necessary; although cases are described where there has been a rapid advance

in the condition following this, I have been fortunate enough not to meet with any.

In cases of bronchitis however slight they may be they are usually aggravated especially by ether.

Nervous System: Patients with an affection of the brain are often in a more or less comatose condition but will respond to the stimulus of the surgeon by inconvenient movements, usually a small quantity of the anaesthetic is sufficient to produce the desired effect. The use of the morphia-chloroform sequence in these cases seems to be now going out of vogue. Hewitt P.178 condemns the use of it in these cases. Dr. Julliard of Geneva in the B.M.J. Vol. 1 1891 P. 920 advises the injection of $\frac{1}{6}$ gr. before ether is given but insists that a trial of the drug on the patient should be made some days previously.

Two cases of Spina Bifida, both under one week old appeared to suffer no ill effects from the administration of a mixture containing equal parts of ether and chloroform given on a lint mask.

Renal System: The fatality, which I have previously mentioned occurred when I was administrating ether, came under this heading, for at the post mortem very extensive tubercvlous disease was found in both kidneys. Ether is generally supposed to be contra-indicated in cases of nephritis on account of the high tension in the circulatory system, being liable when increased to cause cerebral

haemorrhage. There was no sign of haemorrhage in the case I have quoted. I cannot find any literature dealing with the pulse tension in cases of tuberculous nephritis.

NATURE OF OPERATION.

Teeth: Usually a short period of anaesthesia is all that is required for Dental Extractions. Nitrous oxide appears to me to answer admirably, for usually the dentist requires the sitting posture, especially if the teeth are in the lower jaw. The patient recovers quickly enough to be able to expel foreign bodies such as teeth and blood clot from the mouth.

Soemnoform answers equally well, in fact the stage of anaesthesia is somewhat longer than that produced by nitrous oxide.

Operations on the nasopharynx I have referred to when speaking of the obstruction to the respiration by growth in this region.

Operations on the neck:

Deep Dissections in the neck are apt to cause cardiac inhibition due to irritation of the vagus. I have seen a case which was presumably due to this cause, but the depression lasted only a few seconds.

I have, on several occasions, injected small doses of Atropine in these cases to counteract the stimulation of the vagus, but my experience

is too slight to express an opinion on the value of this method. Shäffer in the B.M.J. Oct: 16. 1880 advocates the use of Atropine in conjunction with morphia to prevent cardiac inhibition.

Abdominal Surgery:

The unavoidable shock produced by operations in this region often requires considerable skill on the part of the anaesthetist to avoid collapse of the patient. Also in these cases it is expedient from the Surgeon's point of view that the patient should not be allowed to cough or the breathing be laboured. It is often difficult to steer a clear course between these two evils. Matters are sometimes made more difficult by the use of the Trendelenberg position.

Genitourinary surgery generally requires the patient in the lithotomy position. This is in itself a disadvantage to the anaesthetist, especially when the patient is also suffering from emphysema, the reason being that the abdominal respiration is hampered by the thighs. The surgeon also requires that the anaesthesia should be deep on account of the hypersensitiveness of the part.

Orthopaedic operations: Under this heading comes the often most trying operation of excision of a joint, the amount of shock is in these cases most surprising, Often of course, the patient is in a very debilitated condition, but even this does not always account for the collapse of the subject.

Ophthalmic:

These operations are fortunately usually short, but the difficulties for the anaesthetist are considerable. He is often debarred from using the eye as a guide to the depths of anaesthesia. He has also to avoid interfering with the asceptic precautions of the surgeon. Mr. Snell, the ophthalmic surgeon of the Royal Infirmary, Sheffield, whose house Surgeon I was for some time, does many of his operations with the patient under the influence of nitrous oxide. This anaesthetic he even finds long enough for an enucleation of the eye.

In cases of acute mania the value of an anaesthetic, in some of these conditions, is illustrated by a case of rheumatic fever with maniacal complications, in which the seditives Pot. Brom, Chloral hydrate and hyoscine had been tried without the slightest effect, a few inhalations of chloroform produced sleep from which she awoke some hours later quite rational.

PREPARATION OF PATIENT.

As a general rule a healthy patient should be kept without food for five hours and the last meal should be a light, easily digestible one. This does not apply to young children or to cases of great debility. Children of one year or less often show signs of depression when narcotised due entirely to the fact that they have been starved for too long a time.

In feeble patients it is often advantageous to order half a pint of saline with brandy per rectum previous to the commencement of the operation.

It is customary to give the patient a brisk purgative two nights before the operation: this often adds to the mental distress and should only be used in moderation. It is also advisable to see that the bladder has been evacuated previous to the commencement of the administration, seeing that incontinence does sometimes occur. False teeth should not only be enquired for but the mouth examined for them. I have met patients who have denied possessing any and examination has discovered them. It is a good rule to examine the chest, the pulse and the pupils before the operation.

The temperature of the room should be at least 65° F. for often a considerable part of the patient's body is exposed. This is of some importance seeing that in nearly all cases the temperature of the body falls during the administration. Anaesthetics appear also to take effect quicker in a warm than in a cold room.

Posture: It is the duty of the anaesthetist to see that the position the surgeon requires does not unnecessarily embarrass the respiratory organs. The supine posture with the head slightly extended is the most favourable and the one most commonly adopted.

The lateral posture is useful in operations

about the anus when the lithotomy position causes obstruction to the respiration. In cases of Empyaema it is necessary that the healthy side should be uppermost.

The lithotomy position I have already discussed.

The Trendelenberg position, provided the head is slightly extended is not such an objection as it might at first sight seem. The breathing is rather more laboured probably due to the weight of the viscera pressing on the diaphragm. The pulse rate is also slightly quickened. The feeble shallow breathing ~~patient is~~ sometimes improved by this position being adopted.

The sitting posture I have never used except with nitrous oxide. Snow is said to have administered chloroform to 949 patients in the sitting posture without any ill effects.

REMEDIES & IMPLEMENTS:

A Towel preferably one which is soft and will absorb moisture easily; this is especially necessary when ether is administered owing to the excessive amount of mucous secreted. A gag and tongue forceps are indispensable. It is also advisable to have one or two sponges on holders ready in case it be necessary to clear out the pharynx.

Tracheotomy instruments and the following Drugs;- Strychnine, Amyl Nitrate, Digitalin and Brandy should also be within reach.

The Administration of Chloroform.

During recent years further attempts seem to have been made to revive the use of inhalers for administrating this drug. After the attempts of Snow and Clover to regulate the amount inhaled by a mechanical apparatus there appeared to be a reversion to the open method advocated by Syme and Lister. Mr.Vernon Harcourt (Lancet Mch. 21st, 1903 page 800) describes an apparatus which regulates the dilution and provides an index of the strength of the vapour inhaled, the maximum being 2.5% a lower estimate than that given by Snow. Dr. A. W. Waller in Lancet Nov: 28th, 1903 p. 1481 describes an inhaler of somewhat similar type invented by Dr. Dubois. These inhalers are elaborate and complicated, and more or less untried. The plan I have usually adopted in either administering it on a folded towel or on a Shennan's Mask. Occasionally, I have used a Junker's Inhaler, this apparatus is fairly simple in construction and is very useful in operations about the mouth and nose. It is not easy to narcotise a patient by this method if the mouth tube is used alone; usually, in an adult it has to be supplemented by mask or towel. Professor Zengarle of Constance (Vide Kappelisus Anaesthetica.) from experiments concluded that the speed of pumping is in inverse ratio to the percentage of chloroform in the issuing air; it is therefore somewhat difficult to regulate the amount required; care must be exercised in using this apparatus, for Hewitt P.315

mentions Deaths which have occurred due to liquid chloroform being pumped into the pharynx.

In using the Mask severe blistering of the skin may be caused if any of the chloroform comes in contact with the face - this is easily avoided by smearing a small quantity of vaseline on the face previous to the application of the Mask.

The strength of the vapour which is considered safe is a matter of some dispute. Snow held it to be between 3% and 4%. In the report of the special Chloroform Committee B.M.J. July 18.03 between 2% & 3% is regarded as safe. These figures are hardly of much importance to the practical anaesthetist for unless he uses a somewhat complicated inhaler, the strength and amount of vapour inhaled is impossible to estimate.

When administering on a towel or mask it is advisable to begin with a small quantity and to gradually approximate to the face. A reassuring tone to the patient should be adopted by the administrator for much depends on the management of this stage. It is important to try and not produce the suffocating feeling so often complained of by patients. The subsequent amount and rate of chloroform administered depends on the shape and form of the mask or towel. It should be administered neither too quickly nor too slowly but at a medium rate which can only be ascertained by experience. Should the administration have been conducted too rapidly the patient is apt

to complain of disagreeable sensations of suffocation; is liable to cough and struggle; on the other hand vomiting is very liable to supervene if the addition of chloroform be too tardy. It is convenient to divide the actual administration and its effects into two stages:-

Stage 1. (a) State of unconsciousness.

(b) State of analgesia.

Stage 2. State of complete unconsciousness.

Stage 1. (a) During this stage the breathing should be natural; the pulse rate is generally quickened due to excitement. The pupils are medium. There should, if the patient is tractable and the drug administered with care, be no struggling or sense of suffocation. The duration varys considerably with the physique and condition of the patient. On examination of my notes the average appeared to be between 2 and 3 minutes.

(b) Begins when patient is unable to answer questions intelligibly. The breathing has become more regular and deeper. The pulse rate more rapid; the pupils beginning to dilate. In most cases there is some slight movements of the limbs, usually this passes off quickly and can hardly be termed excitement. Sometimes the patient utters a few incoherent noises. Old men almost constantly attempt to raise themselves into the sitting posture. During this stage there appears to be a tonic rigidity especially of the flexor muscles. It is wise to withdraw the anaesthetic on account of the deep inspiration which follows this unconscious exertion.

The violent struggles of alcoholics are of different nature, generally appearing to aim at the removal of the mask.

Fatal chloroform syncope is said to occur more commonly at this stage than any other. Lawrie (Chloroform P.31) explains that this is due to the inhibition of the heart during the struggling, followed by the increased intake of chloroform produced by the exaggerated inspiration. This he deduces from the fact that during the actual struggling the blood pressure falls rapidly, which he considers due to vagus inhibition. This appears to be an acceptable theory; it is therefore advisable to withdraw the towel or mask from the face when the patient is struggling.

Vomiting, as I have previously mentioned, is liable to occur especially if the administration has been too slow and may cause somewhat alarming symptoms. Pre-vomiting signs are pallor, shallow breathing and low volume pulse. The pupil is also often very dilated. Children often have very confusing signs, Simulating deep anaesthesia when in reality they are only in the stage of analgesia.

Stage 11. is ushered in by regular deep respiration. The pulse rate is, as a rule, slower although in some of the cases of which I have notes, it is still rising during this stage. The pupil is medium or slightly contracted. The lid reflex is absent. The corneal reflex may or may not be absent. There is often strabismus. The pupils react to light;

This is often difficult to see especially if they are dilated, but I believe is always present, even in deep anaesthesia. The face has a tendency to paleness. The temperature is lower. There is no or only slight movement reflex from any external stimulus.

The most important guides to this stage of surgical anaesthesia are:- Firstly, slight snoring respiration. If this is shallow it may mean that the narcosis is too light or the reverse; to distinguish between the two states one must examine the pupils and corneal reflex.

Crowing respiration in children resembling somewhat the inspiratory sounds in laryngismus stridulus, is occasionally very persistent and I know of no remedy for the same. It does not appear to be governed by position or amount of chloroform inhaled.

Swallowing movements are an indication of light anaesthesia and are a guide to the anaesthetist.

The lid reflex should be abolished or only occasionally present.

Pupils should be rather small. When widely dilated they may, like shallow respiration, either mean too light or too deep anaesthesis. This state should be distinguished by the foregoing signs.

The pulse is not of much value; in fact, according to the teaching of Syme may be almost disregarded as an indication of the stage of anaesthesia. Of course, it is of great value as a sign of the effects the operation has on the patient.

Colour of the face is naturally somewhat pale during anaesthesia. The increase of the condition is often one of the first signs of danger to be noticed. Pallor is often an indication of vomiting as previously mentioned.

Notes on cases of Chloroform Anaesthesia:

The following cases are typical of successful administration.

Case 16: Well developed female, age 52. Operation was removal of a tumour growing on sole of foot. Supine posture. pulse 84. Pupils medium. She had no obvious cardiac or other disease. Chloroform administered on Skinner's mask.

5.19 Administration begun.

5.20 Breathing somewhat shallow.
Pupils medium.

5.22 Slight excitement. Purposeless movements of arms and legs.

5.22½ Excitement stopped.

5.25 Conjunctival reflex absent. Pulse 100.
Pupils dilated.

5.26 Corneal reflex absent.

5.32 Pulse 56.

5.34 Operation finished.

5.34¼ Corneal reflex again present.
Light reflex was present throughout. There was no vomiting afterwards.

Case 22:- Girl aged 4. Operation for enlarged Tonsils and adenoids. Patient robust. Chloroform administered on Skinner's Mask.

11.21 Administration begun. Child crying. P.120. Pupils medium.

11.22 Crying stopped. Breathing regular.

11.22½ Conjunctival reflex disappeared.

11.23¼ Corneal reflex disappeared. Pupils contracted. Operation commenced. Chloroform removed.

Only one drachm of chloroform was required in this case. She was able to cough immediately the operation was completed.

The following case is interesting on account of the sudden stoppage of the respiration 8 minutes after commencement of administration. A Boy aged 10. Operation Radical Cure of Hernia. Patient rather delicate looking. Pulse 120. Pupils medium. Chloroform administered on Skinner's Mask.

12.32 Administration commenced.

12.35 Breathing regular. No excitement. Pupils contracted.

12.37 Pulse 96.

12.39 Respiration shallow.

12.40 Respiration ceased. Radial pulse imperceptable. Compression of chest. Artificial respiration. Lig. strych. m $\overline{\text{lll}}$. injected hypodermically. Breathing commenced again in few seconds. Patient speedily recovered. Only 2½ drachms of chloroform used.

Dangers during the Administration of Chloroform.

Julliard (Vide Hewitt P.342) out of 210 fatalities under this drug. 90% occurred within the

first fifteen minutes. I was present on one occasion when death occurred under chloroform. It took place about nine minutes after the commencement of the administration. The patient did not struggle, but a few seconds after the incision (to open an abscess of face) the respiration suddenly ceased. No radial pulse could be felt. The usual restoratives were applied with no result. Post Mortem, Fatty Infiltration of the heart also a large Psoas abscess. Was death in this case due to surgical interference? No doubt in some cases the first incision does depress the circulation, yet again in others it acts as a decided stimulus. Vomiting does lower the blood pressure to a certain extent judging from the pulse and colour of the patient, yet I cannot find any record of a patient dying during this act, except when food has been sucked into the larynx. Possibly, death may occur during the prevomiting stage before the actual act.

Over-dosing during this stage of excitement I have already referred to.

The secretion of mucous is spoken of as a danger in the administration. In the majority of cases this is a negative quantity. In those cases in which it does occur I have noticed it is in the early stages, therefore one can conceive that it may be of importance in respiratory embarrassment due to struggling.

The administration of ether.

In the following pages when mentioning ether,

I refer always to the pure ethylic ether, not to the methylated preparation, Though the latter is extensively used in some hospitals, also with but a few exceptions I have administered this drug in the inhaler known as Clover's portable inhaler. The exceptions have been when I have anaesthetised very young children by the open method. There are in my opinion numerous objections to the use of ether. Many of these I have already referred to. Amongst other objections I may mention the inflammability. This, with ordinary precautions, should not be a serious matter and I have never seen any accident occur whilst the administration was proceeding. On one occasion, one of the nursing staff was slightly burnt due to her carelessness in emptying an inhaler in the vicinity of a gas stove. Kappeler (Anaesthetica P.173) quotes a case where the patient was somewhat severely burnt. Respiratory embarrassment is caused by swelling of the tongue and salivation. The latter difficulty is often considerable and is, as yet, not fully explained. It is probably due directly to the irritating effects of the vapour, but why it should occur to a patient on one occasion when under ether, and not at another is not very obvious. To prevent the hypersecretion I have on several occasions tried the effects of small doses of atropine hypodermically, hoping thereby to inhibit the secretion. The cases have hardly been numerous enough for me to form any definite opinion as to its value. Respiratory embarrassment may also

occur due to the non-fitting of the face piece; especially is this the case in edentutous patients. I have generally found a small Dental gag to be of service in these cases.

There is considerably more vascularity of the tissues with ether than with chloroform. This is more evident during the first ten minutes of the administration.

The actual process of administration adopted by me has been as follows:- First, to explain to the patient that an suffocating feeling he may experience is necessary, but of no importance. Ask him to breathe deeply. Then, after he has taken a few breaths through the inhaler without the bag, replace the bag and gradually turn the indicator, each turn should be during expiration. I find the average time taken to reach the division marked (1) is 1½ minutes, then more quickly,(2½) is reached. By this time the patient will be approaching the stage of anaesthesia. This may be reached often without taking the indicator further, provided it is kept at the division for about one minute afterwards. It may be turned to mark(1½.) The patient may then be allowed a breath or two of air, once in every eight respirations. This description answers to the administration of ether to a person of medium build. In plethoric and alcoholic individuals pure ether vapour must be breathed sometimes before they are narcotised; on the other hand, anaemic patients require less than above-mentioned. I am of the opinion that

the less concentrated the vapour the less likely is one to have hypersecretion of mucous.

Effects produced by the administration may be like those of chloroform, divided into two stages. Stage 1 (a). Stage of Consciousness. Patient complains of unpleasant sensations, and is apt to struggle. purely from fright. The respiration immediately becomes deeper. The pulse rate quicker.

(b) Semi-consciousness. Answers questions incoherently; pupils dilating. Breathing deep and irregular. Duskiness of face; often profuse perspiration and salivation; general muscular spasm or violent struggling which is purposelike but to be distinguished from efforts to remove the inhaler due to fright.

Stage 2. Breathing stertorous. Pulse full. Bounding can easily be felt in Temporal Artery but not so rapid as in first stage. Pupils slightly dilated. Eyes fixed. Colour of face depends on the amount of air patient is permitted. Often slight rigidity. Corneal reflex absent.

The guides to proper anaesthesia are:- the respiration becomes shallow when patient coming round. Swallowing movements have the same indications. The lid reflex should not be present. The conjunctival and corneal reflex should be in abeyance. This is often brought about falsely by too frequently testing for it, the cornea and conjunctiva becoming insensitive. The changes in the pupil are much the same as those of chloroform anaesthesia, but are usually more dilated. The to and fro movement of the globes is very marked when the patient is coming round.

Dangers:-

When the administration is pushed beyond the Stage 2. I was present when due to a faulty inhaler this was the case. The patient was a youth aged about 17. Was being operated upon for hip disease. The respirations gradually became shallow. The pupils more dilated. The colour of his face became dusky. The pulse could not be felt in the temporal. The inhaler was removed and the patient gradually recovered.

In the case of the fatality which, I have already mentioned, occurred whilst I was administrating ether, the effects were different. This patient was a man aged 35. The operation was to have been an exploratory laparotomy. He suddenly stopped breathing at the time a catheter was being passed. The administration had then lasted about 10 min. His colour became livid. There appeared to be no obstruction to the respiration. The radial pulse failed at the same time. All efforts to resuscitate him were of no avail. Post Mortem examination showed extensive tuberculous disease, of both kidneys. This patient, in the opinion of those present, died from cardiac syncope.

After effects:- According to the testimony of experienced nurses these are more disagreeable than those of any other anaesthetic. Even when vomiting is not severe, patients complain bitterly of the odour which always clings to them, even upsetting patients in neighbouring beds.

The tendency to Bronchitis and pneumonia I need not again refer to, as I have already mentioned them at some length when speaking of the comparison between ether and chloroform.

Case showing the sequence of events in ether Administration:-

Case 31:- Female age 49. Anaemic. Fibroids of uterous. Operation hysterectomy. Pulse 114.

regular ~~tension weak~~. Pupils contracted.

4.25 Commenced anaesthetic. Respiration 22.

4.27 Breathing regular. Pupils contracted.

4.30 Slight rigidity.

4.32 Pupil contracted. No corneal reflex. Patient under

4.35 Pulse 96. Respiration 36. Colour improved. Pupils still slightly contracted. Stomach tube passed to relieve distension of stomach.

4.45 Pulse 120. Respiration 42. Colour good. Pupils contracted.

4.55 Pulse 114. Respiration 48.

5. 2 Pupils dilated. Ether stopped.

5. 3½ Pupils contracted. Ether resumed.

5.20 Pulse 120. Respiration 48.

5.25 Pupils dilated. Ether stopped.

5.28 Ether resumed.

5.40 Pulse 96. Respiration 54.

5.47 Operation finished.

Case 25:- Male aged 52. Fair condition. Carcinoma Recti. Exploratory laparotomy.

3.29 Pulse 92. Pupils medium. Ether commenced.

3.32 Pupils medium. breathing irregular.

3.35 Some excitement: indicator 2¼. Pulse 96.

3.37½ No corneal reflex. Breathing regular.

Operation commenced.

3.45 Pulse 132.

3.50 Pupils dilated. Corneal reflex present.

4. 1 Pulse rate declining. Breathing deep.

4.10 Pulse 92. Breathing deep.

4.29 Operation finished.

Quantity of ether used 3⅛ ounces.

After effects:- Patient vomited once only.

Amaesthesia of short duration.

Of anaesthetics answering this requirement we have now a considerable number, amongst those most used are nitrous oxide and ethyl chloride and its compounds. I propose giving an account of soemnoform (a mixture containing ethyl chloride) from a clinical standpoint.

SOEMNOFORM.

This is an invention of Dr. Rolland of Bordeaux and is a mixture containing chloride of ethyl, chloride of methyl and bromide of ethyl in the following proportions:-

Chloride of ethyl.	60%
Chloride of Methyl.	31%
Bromide of ethyl.	5%

It was first introduced into England by Drl Rolland at the British Dental Association at Shrewsbury in 1902. Since that date it has been extensively used throughout the Kingdom, the

inventor claiming that during the last 12 months 100,000 administrations have been given without a fatality. The anaesthesia is of short duration and is therefore suitable for minor operation and dental extractions.

The drug is a transparent colourless highly volatile liquid of a strong sweetish odour. Has a local anaesthetic action on accounts of its rapid evaporation. It is sold in small bottles with a simple valve arrangement or in capsules each containing 5.c.c. Any form of inhaler is suitable provided that re-breathing is accomplished. A very simple form is an ordinary Clover with a piece of lint in the face piece on which to spray the drug. The dose necessary varys from 3 c.c. to 5 c.c. depending largely on the inhaler. My own experience with it is that it compares very favourably with nitrous oxide. Anaesthesia is very quickly induced, more quickly than with nitrous oxide in many cases. The anaesthesia lasts about 20 seconds; the return to consciousness is somewhat slow compared with nitrous oxide. As yet, I have seen no ill effects follow its use. It is advisable to see that the face piece fits accurately and to explain to the patient exactly what is required of him before proceeding with the anaesthetic. These precautions are necessary on account of the rapidity with which the drug evaporates. As soon as the desired quantity has been sprayed into the inhaler, the latter should be adjusted to the face and the patient told to breathe deeply and hold up one arm. It is not

essential that an arm should be held up but it is a convenient method of showing the stage of anaesthesia. The alternative is to tell the patient to follow with his eyes a moving object such as the administrator's finger. When unconsciousness supervenes the eyes have a fixed position and fail to follow the movements. The conjunctival reflex is sometimes present during complete anaesthesia; therefore, not being a reliable guide. Loss of sensibility occurs usually after about 10-20 deep breaths; it is then advisable if only a short period of anaesthesia is required to remove the inhaler, or if longer period be required, to admit a little air and re-apply.

The effects of the administration may as in chloroform and ether be divided into stages:-

Stage 1:- Stage of consciousness. Patient breathes more deeply than normally; the respiration is also somewhat irregular. The pupil does not appear to alter in size. The eyes are able to follow the movements of the anaesthetist. The pulse is somewhat accelerated, probably due to the excitement. The face does not alter in colour. This stage lasts on an average about 15 seconds.

Stage 2:-is ushered in by more regularity of the respiration, by the extended arm falling to the side. The eyes as previously mentioned assume a fixed position. The conjunctival reflex is usually present. Patient is insensitive to pain. If the inhaler is then removed I have found that unconsciousness lasts about 15 seconds.

After Effects:- The return of true consciousness is somewhat slow compared with the duration of the anaesthesia. The patient often mutters and talks incoherently, stares vacantly about him. This soon passes off and the patient is able to stand or walk and suffers apparently no ill effects.

One of the most frequent disadvantages which have occurred to me whilst administrating soemnoform was the somewhat violent jactitation of the limbs which occurred during the second stage. This was well exemplified in a case where I anaesthetised a patient with Soemnoform in order that a dislocated shoulder might be replaced. This patient struggled so violently that the surgeon was unable to reduce the dislocation by Kocher's method, but did it with traction and heel in the axilla. This patient struggled continuously after about the first 10 inhalations but on recovery informed us that he had experienced no pain.

Cases illustrating the administration of Soemnoform.

Male aged 35. Medium build. Operation for strangulated hernia. Condition fair. Vomiting for last 15 hours. Pulse 104. Reppirations 26. 5.c.c. of Soemnoform sprayed on to the Mask. Left arm held upright. Breathing irregular and deep for 10 inspirations. Pupils medium unaltered. Arm fell to side. Patient on being told to hold it up again did so. After the 10th inspiration breathing deeper and more regular. Arm gradually

falling again. Face slightly flushed. After the 24th inhalation arm had fallen to side. Eyes became fixed. There was considerable perspiration on forehead. Mask was then removed and a Clover's inhaler substituted, with the indicator at 1½. This administration was very successful. There was no excitement and the change to ether was affected without any coughing or other signs of incomplete anaesthesia.

Case 2:- Man aged 42. Medium build. operation Incisions in a cellulites of arm. 5.c.c. of soemnoform sprayed into face piece. Left arm held upright. Breathing somewhat irregular. Pulse 104. After the inspirations breathing more regular, eyes fixed, arm falling to side; jactitation of limbs; after 16 inhalations operation commenced. No reflex movement. Pulse fallen to 90. Mask removed. jactitations still continued. 25 inhalations operation finished. 10 seconds later patient began to talk incoherently. In about 20 seconds was quite conscious. There were no after effects as nausea or vomiting.

In this case the movements of the limbs were a considerable inconvenience to the surgeon; otherwise the administration might be said to be successful.

Difficulties arising during Administration of Anaesthetics.

Struggling will occur in timid individuals especially in well built men, sometimes before the anaesthetic has really had any effect on their co-ordination and is, I am inclined to think, entirely

due to fright. It is more frequently seen when ether is administered. To avoid this, a reassuring tone should be adopted with the patient, and on no account should any restraint be put on his movements unless he is actually struggling.

The struggling which occurs later during the administration is usually not so violent and is more easily managed, usually occurring in old men and alcoholics.

Coughing: Though advantageous in some cases is of considerable annoyance in others. It can only occur during incomplete anaesthesia. It is often preceded by the act of deglutition which should be watched for. I have noticed that patients anaesthetised, shortly after a meal, are more liable to cough. Frequently, it is entirely due to the vapour of the anaesthetic being too strong, the remedy in such instances is obvious.

Difficulties and Respiration.

Obstruction not due to foreign bodies.

The tongue is inclined to fall back when the patient is anaesthetised in the supine posture and is probably by far the commonest cause of obstruction of respiration. It can easily be accomplished by pushing the angles of the jaw forward or by drawing the tongue by means of the tongue forceps. The latter instrument I have noticed is seldom required by experienced administrators, as they are able by manipulating the jaw to obviate any faulty position of the tongue. Simply closing the mouth will in many instances answer the purpose. In cases

where in addition to this difficulty there is still further obstruction, due to tonic spasm of the muscles of the chest and larynx, one must have resource to artificial respiration or chest compression. I have fortunately never seen any case where these measures failed to re-establish regular respiration, however, cases are described where laryngotomy has been necessary (vide Hewitt P.448)

Difficulties in respiration due to foreign bodies.

Blood is recognised by coarse râles and is especially liable to occur in patients who are being operated upon for enlarged tonsils and adenoids. To avoid it the patient should be operated upon in the sitting posture or supine with head extended. The latter is, I think, preferable, unless the patient is only very lightly narcotised. The condition is easily recognised and immediate steps should be taken to induce the patient to cough. This is best accomplished by douching the face with cold water and compressing the chest, failing this invert the patient or perform laryngotomy. This (laryngotomy) was the means of saving a child's life at this hospital about a year ago.

Vomited Matter:

Vomiting is a frequent sequel to anaesthesia, less often it occurs during the first stages of the administration. If the patient has been properly dieted it is not of much moment, but if, on the other hand, a meal has been taken shortly before the administration has begun, then vomiting of large quantities of undigested food may cause considerable

anxiety. Fortunately, the laryngeal reflex is usually present and the patient is able to expel any matter which may enter that organ, by coughing. If prevomiting signs occur the patient should immediately be turned on his side, the mouth opened by a gag and the pharynx sponged out. Should there be any actual obstruction, then the index finger should be inserted into the pharnyx and the offending material scooped out. Failing this, the case should be treated on the same lines as when blood enters the larynx.

Excessive secretion of mucous which occurs so frequently in ether anaesthesia, should be dealt with in a similar manner. It is a good plan to keep the end of a towel between the teeth and cheek on the side to which the head is turned. This acts as a drain by capilliary attraction and is very useful.

Teeth: During dental extractions teeth are apt to slip into the pharynx in spite of all precaution. I can recall a case where this apparently happened. The tooth was never found and I believe was swallowed. These accidents are not so liable to occur if the upright posture is used.

Obstruction due to posture and clothing:

I have already discussed the disadvantage of the lithotomy position. When this position is adopted it is the duty of the anaesthetist to see that the chin is not placed on the sternum. Patients in my experience breathe better when a pillow is inserted under the shoulders and the head kept extended. Other positions I have also commented upon. Bandages

about the head should be sufficiently slack to avoid any obstruction. The clothing of course should not be tight ih any way.

Paralysis of Respiration due to overdose of anaesthetic:- This may occur suddenly or more commonly gradually. In the latter case actual stoppage of respiration may sometimes be avoided by promptly withdrawing the anaesthetic and stimulating the patient by rubbing the face briskly and douching with cold water. The latter measure I have found very expedient in a case of this kind. When the respiration has actually ceased, artificial respiration should be immediately employed. Tongue traction alone without artificial respiration I have not found to be very efficatious. Inhalation of oxygen advocated by Fay (B.M.J. Jan: 1892) may be also tried provided it does not interfere with the other manipulations. Amyl nitrate is I think of doubtful value, When the failure of respiration is due to overdosing, for in these cases there is considerable lowering of blood pressure which is likewise the physiological action of the drug. Other drugs I am of opinion are only of secondary consideration and no time should be wasted in using them. If there are plenty of assistants ether and strychnine may be injected hypodermically. A hot sponge applied over the cardiac area I found to act most efficiently on one occasion. No doubt of all these remedies artificial respiration is by far the most important and should be well tried, even when the patient appears apparently lifeless. In the Edin. Med.

Journal Nov: 1874 recovery is described after 2½ hours artificial respiration.

Inhibition of heart due to overdose of Anaesthetic:- The vigour of the circulation is depressed by many diseases especially primary and secondary anaemias. The heart in these patients requires less of the anaesthetic to inhibit its action. Therefore, it is in these cases that syncope is most likely to occur. It may supervene with great suddenness or on the other hand it may be gradually brought about. The latter cases are the most hopeful, as remedies may be taken before cessation of the heart beats occurs. Failure of the radial pulse is of course not a sign that the heart has ceased to beat. Numerous cases are recorded when due precautions have been taken and the patient recovered even when the radial pulse has been absent. Drugs here again are of but little value seeing their action depends on their diffusion through the circulation, which is impaired. Partial inversion is in this case the most reliable remedy and should be resorted to immediately, in all cases of primary cardiac failure. As respiration usually stops at the same time, artificial respiration should likewise be resorted to.

In cases where the circulation is suddenly depressed the above named remedies should be tried but are probably of little avail.

Surgical Shock:-

Of these cases I have had considerable

experience; usually I find it comes on slowly unless it be due to sudden haemorrhage. I have chiefly met with it during long abdominal operations, less frequently during excisions of joints and amputations.

The indications are gradual on-coming pallor of the face, slight cyanosis of the lips, usually, though not always so, shallowness of the respiration, and a characteristic pulse of small volume and tension. Coldness of the extremities is also a reliable sign of shock.

This condition may to a certain extent be combated with warmth, by such drugs as Brandy, strychnine and digitalis. In severe cases I have great faith in the infusion of sterilized saline solution, directly into the circulation.

After effects of Anaesthetics.

The sequence of events after withdrawal of the anaesthetic are much the same in each case and occur as nearly as possible in inverse order to which they appeared before anaesthesia. First the reflexes return almost at the same time the respiration becomes shallower. The pupils become smaller - later the acts of coughing and vomiting are established. Then phonation may occur and lastly the consciousness of the patient.

The rapidity of the recovery depends largely on the amount of the anaesthetic used and length of the administration.

Patient on recovering consciousness usually complains of feeling cold. Extra clothing should be in readiness and if the patient is vomiting a hot saline injection per rectum will be found to afford much benefit.

It is my custom to order nothing to be taken by mouth for 4 - 5 hours, after that time, to allow the patient to have tea or milk and soda in small quantities.

Vomiting is one of the most disagreeable after effects and is sometimes most difficult to check. I have noticed recently that patients who have had injections of strychnine whilst under the anaesthetic apparently do not vomit so frequently as patients who have not had this drug. Possibly, there have been other factors to account for this.

It is important not to allow the patient to sit up for some time after regaining consciousness, as this will often induce violent vomiting.

Hypodermic injections of morphia is probably one of the most reliable aids. It relieves the restlessness, induces sleep and probably inhibits the peristaltic movements of the stomach.